

# Information system for public transportation and corresponding communication method

This application is a continuation application of PCT/CH99/00299 filed on July 6, 1999.

## 5                    Field of the invention

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The present invention lies in the field of traffic telematics (tele-transmission of computerized traffic information) and concerns a communication system for vehicles, for example a communication system for public transportation vehicles such as for example trains, buses or  
10       subways.

## Related Art

Systems are known with which data, for example multi-media data, for example an entertainment program, can be distributed to passengers of a vehicle. Some systems are interactive and have a reverse  
15       channel over which the passengers can for example order a new entertainment program or participate in game contests. These systems generally use terminals that belong to the vehicle. A disadvantage of these systems is that the passengers are seldom familiar with such terminals so that only simple functions can be proposed. In order to prevent the  
20       terminals from being stolen, non-standardized devices that are useless outside the vehicle are often put into use. Such terminals not destined for the broad public are however usually expensive.

In addition, systems are known for checking electronically the travel authorization of passengers. Such a system has been described  
25       among others in patent EP0465456. Trains are equipped at the doors with appropriate readers in order to record the ingress and egress of passengers who have been provided with a contactless identification element. Travel data comprising the time of ingress and egress of every identified passenger are forwarded from the trains to a central that bills the traveled

It is an aim of the present invention to propose a new and improved communication system for vehicles, in particular for public transportation vehicles.

It is another aim of this invention to propose a new communication system that is compatible with a plurality of terminals that can also belong to the passengers.

15 According to the present invention, these aims are achieved in particular through an information system having the characteristics of claim 1.

In particular, these aims of the invention are achieved with an information system in which the data within the vehicle can be transmitted to the passengers over a data bus and a plurality of contactless transceivers.

A standardized contactless interface is preferably used in order that the passengers can use their own familiar terminal.

Central data processing means are provided in the vehicle and are connected with said data bus. The contactless interface is preferably bi-  
25 directional so that data can be transmitted in both directions between the passengers and the central data processing means.

The method according to the invention can thus be used for distributing information, for example travel information, and entertainment programs, including advertising, as well as for billing the traveled distance.

#### 5                    Description of the drawings

Preferred embodiments of the invention will be described hereafter in more detail with the aid of the attached drawings, in which:

Fig. 1 shows a diagrammatic view of a vehicle, in this example a bus, with an information system according to one embodiment of the invention.

Fig. 2 shows a block diagram of the system according to the invention.

Fig. 3 shows a diagrammatic view of another embodiment of an identification module, here in the form of a portable radio receiver.

Fig. 4 shows a diagrammatic view of another embodiment of an identification module, here in the form of a wristwatch.

Fig. 5 shows a diagrammatic view of an identification module, in this example a contactless chip-card, with an authorization-checking device, in this example glasses with a VRD (Virtual Retina Display).

#### 20                    Detailed Description of the Invention

Figure 1 shows a vehicle, in this example a bus 35, with an information system according to the invention. The invention can however be used for any type of public transportation vehicle, for example also for trains, subways, boats or airplanes.

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The information system comprises central data processing means 2, for example a computer with appropriate interfaces, or a digital radio receiver with a processor, as well as a data bus 3 that connects the central data processing means 2 with a plurality of transceivers 31, 32. Each  
 5 transceiver has an antenna oriented within the vehicle and in the direction of the passengers. Certain transceivers 32 are preferably installed close to the doors in order to monitor the ingress and egress of passengers.

The central data processing means 2 have, or are connected with, at least one radio receiver 21 over which data from at least one sender 1, 7,  
 10 8 (Fig. 2) outside the vehicle can be received. According to the application, the radio receiver 21 can receive and/or send and if necessary process the following data:

- Radio programs, preferably digital radio programs of a radio station 1 broadcasting according to the DAB (Digital Audio Broadcasting) standard, including accompanying data;  
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- Television programs, preferably digital television programs, for example according to the DVB (Digital Video Broadcasting) standard, including accompanying data;
- Data transmitted through a mobile radio network 6, for example through a GSM (Global System for Mobile Communications) or UMTS network, including SMS (Short Message System), USSD (Unstructured Supplementary Service Data) and WAP (Wireless Application Protocol) data, it being  
 20 possible to exchange these data with a mobile device 8 or with a server 7;  
 25
- Data from a location-determining system, for example GPS data;
- Data from another vehicle, for example data from another coach in a train;

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- etc.

These different data are converted in the data processing means 2 into another format, for example in the Bluetooth format, and addressed over the electronic bus 3 and the transceivers 31-32 to the passengers 36 in question.

The passengers 36 have personal terminals 4, each terminal containing an identification module 40 (Fig. 2) in which user-specific data are stored, as well as a contactless interface 41 over which a radio connection can be established with the transceivers 31-32.

10 The contactless interface 41 allows a radio connection at close range (typically up to a maximum of 20 meters) and comprises preferably a chip, for example a RFID (Radio Frequency Identification) chip, and an antenna. The chip comprises a radio part and data processing means in base frequency range and operates for example in microwave range.

15 Depending on the frequency used, the antenna can also be integrated in the chip or consist of a wound coil.

According to the embodiment, the terminal 4 can be in the form of a portable radio receiver 42 (Fig. 3), of a mobile telephone (not represented), of a palmtop or laptop computer (not represented), of a wristwatch 43 (Fig. 4), or of a chip-card 44 (Fig. 5), preferably in ISO format.

20 Terminals of different types can also be combined within a single vehicle. According to the embodiment, the terminal can have different data reproduction means 400, for example a display and/or loudspeaker, and different input means 401, for example a keyboard, a touch-screen and/or

25 an apparatus for determining the position of the eye. The display can be for example a LCD (Liquid Crystal Display) and/or preferably a VRD (Virtual Retina Display) and thus reproduce the operating status as well as received images and texts. The identification module 40 consists for example of a removable chip-card, for example a SIM (Subscriber Identification Module)

30 card, or of a secured storage area (virtual SIM card) in the terminal. The contactless interface 41 preferably allows a bi-directional data transfer with

the transceivers 31, 32. Preferably, a standardized protocol is used for this interface, for example the Bluetooth or HomeRF protocol, so that standardized terminals 4 can be used. The contactless interface can also consist of a RFID (Radio Frequency Identification) element. According to the  
5 embodiment, the terminal 4 has its own energy supply means, for example a battery or solar cell, or can be powered by the transceivers 31-32.

In a variant embodiment of the invention, at least some of the terminals contain an additional radio receiver 46, with which data from an external sender can be received.

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10 When the passenger 36 enters the vehicle 35 with his terminal 4, his identification parameters stored in the identification module 40 are collected over said contactless interface 41 and the transceivers 32 near the doors and transmitted to the data processing means 2. The passenger's identification parameters comprise for example his name, his user number  
15 and if necessary the identification of his home provider. If the identification module 4 can also be used as a SIM (Subscriber Identification Module) card in a mobile telephone, the user's identity can also consist of his IMSI (International Mobile Subscriber Identification) number in the mobile radio network. In a variant embodiment, biometric parameters, for example a  
20 photograph, a finger print or an image of the passenger's retina are also stored in the identification module 40.

In a preferred embodiment, authorization data of the passenger are also read by the transceivers 32, the authorization comprising for example booking data, type of season ticket, pre-paid tickets etc.

25 According to the embodiment and application, the transmission of the identification parameters when entering or leaving the vehicle 35 can be triggered by the passenger or the transceivers 32. The identification parameters are read in the identification module 40 by a software program executed by the terminal 4 or the module 40 and transmitted by means of  
30 appropriate communication protocols over the contactless interface to the

transceivers 32, where they are forwarded over the mentioned electronic bus 3 to the central data processing means 2.

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A software program in the data processing means 2 records the passengers' time of ingress and egress and determines with it the travel fee  
5 to be billed. If the data processing means 2 are connected with a location-determining device, the users' place of ingress and egress is preferably also used for billing. The computed fee can then be billed with a monthly fee of the transport company or, in a variant embodiment, it can be debited  
10 directly over said contactless interface from a pre-paid electronic account in the users' identification module 40.

The data processing means 2 can receive over said additional radio receiver 21 a list of authorizations resp. of bookings or of blocked  
identification modules and thus establish whether the passenger is allowed  
15 to enter or whether he is barred from the vehicle. If the passenger is barred from the vehicle, the data processing means 2 can for example take appropriate measures in order to refuse access to the passenger, for example acoustic or optical warning signals can be activated and/or the relevant entrances closed resp. not opened.

If the passenger is allowed to board, he can enter the vehicle and  
20 take a seat. In the vehicle, additional transceivers 31 are provided that collect the identification parameters in the passenger's identification module 40 and forward them to the central data processing means 2. These data processing means can for example check whether the passenger is occupying the seat reserved for him in an allowed travel class. For this  
25 purpose, the transmitted authorization data can for example include booking information and/or travel class indications.

The bookings can be made by the passengers in advance over any sales channel, for example by telephone, over the Internet, at a counter or  
30 with the method described in patent application PCT/CH96/00464. The booking details are preferably stored in a server 7 of the transport company and are either downloaded in the identification module 40 or

transmitted over the mentioned radio receiver 21 to the data processing means 2. If the booking indications are available in the identification module, the passenger can read this booking, for example the seat number, on the display 400 of his terminal 4.

5                If the passenger moves towards a seat that is not allowed to him, a written or spoken message can appear on his personal terminal. When he finds his reserved seat, he can be welcomed by name; the reserved seat can then be labeled as "reserved" or "reserved and occupied".

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10                When the passenger 36 is seated at his seat, he can receive data over the transceivers 31 and have them reproduced or processed on his personal terminal 4. The data received can include for example tourist information, advertising, music, entertainment programs etc. Certain data can be generated by the vehicle's driver and transmitted over the electronic bus 3 to every or to selected passengers. Other information, for example

15                DAB or DVB programs and accompanying data received over the radio receiver 21, can be converted into an appropriate format, for example Bluetooth format, and addressed to the passengers 36.

20                If the data processing means 2 are connected with location-determining means 21, for example with a GPS receiver, location-dependent data can also be transmitted to the passengers, for example indications relating to the next stop. This location-dependent information can be either generated in the vehicle 35 and/or received as program-accompanying data and filtered depending on the location information determined in the vehicle.

25                The interface between the terminals 4 and the transceivers 31 is preferably bi-directional. The passengers can thus, with appropriate controls of their terminals, trigger certain actions with the data processing means. For example, every passenger can request over this channel that the vehicle should stop at the next station or request a change of seat and/or

30                class.



The position of the identified passengers in the vehicle is preferably stored temporarily in the data processing means 2. In this way, for example certain data sent over the data bus can be addressed according to said stored position and forwarded only by the transceiver that is  
 5 situated closest to the addressed passenger.

The passengers in the vehicle can communicate with one another over said data bus, for example telephone or play with one another. If the data processing means 21 are connected with a mobile radio system 6, for example with a GSM or UMTS mobile radio system, the passengers can also  
 10 log into this mobile radio system over the aforementioned contactless interface 4-31 and the data bus 3 and establish connections. In this manner, passengers who have no mobile radio telephone but have a terminal 4 with a suitable interface 41 can make telephone calls or send and receive e-mails when they are in the vehicle 35.

For this purpose, in a first variant embodiment, temporary IMSI (International Mobile Subscriber Identification) and MSISDN (Mobile Subscriber ISDN) are provided by the operator of the vehicle 35. Each vehicle 35 has in this embodiment one or several IMSI numbers that are converted in the data processing means 2 into a suitable address for the  
 15 data bus. In order to establish a connection, a passenger borrows one of the available IMSI numbers allocated to him during the connection. In this embodiment, the telecommunication costs incurred during the connection are charged by the operator of the mobile radio network 6 through known mechanisms to the operator of the vehicle 35, who bills these costs with a  
 20 supplement to the passenger on the travel bill.

In a second variant embodiment, the passenger has a subscription with the operator of his home mobile radio network 6. The IMSI number and the MSISDN number are then stored in the identification module 40 in the terminal 4 and are forwarded to the data processing means 2 as soon as  
 30 the passenger has taken his seat. The communication system in the vehicle 35 behaves in this embodiment as a visited network (VPLMN – Visited Public Land Mobile Network) with a roaming agreement with the operator of the

mobile radio network 6, and administers a visitor register (VLR – Visitor Location Register), into which the passenger's IMSI is copied. The mobile radio part connected with the data processing means 2 can log into the mobile radio network 6 through the known roaming method with this IMSI number, so that calls can automatically be forwarded to the passenger. In this embodiment, the mobile radio network operator can charge the incurred telecommunication costs directly to the user of the terminal 4. The billing receipts established by the mobile radio network operator, for example CDR (Call Details Records) can for example be converted in the data processing means 2 into a suitable format in order for them to be forwarded over the data bus 3 and for example automatically debited from an electronic account in the identification module 4 or billed monthly.

The system according to the invention can also be put to use when the travel authorization is not checked at ingress and egress, but within the vehicle. For this purpose, a so-called polling method can for example be used. In this case, the central data processing means call up all passengers in the vehicle at regular intervals. Every terminal 4 receiving this call replies with a message in which the identification data are preferably comprised. In this manner, the central data processing means regularly receive a list of all terminals in the vehicle.

The system according to the invention can however also be used when the tickets are checked by a controller 9 (Figure 5). The controller has in this case preferably a portable authorization-checking device 90 having, integrated in the housing 91, a contactless interface that can connect with the passengers' terminals in order to collect the authorization and identification data stored in the identification module 40. The data collected comprise for example the passenger's booking details and electronic ticket resp. season ticket, as well as, in a preferred embodiment, biometric parameters of the passenger, for example a photograph of the passenger. On the basis of these biometric parameters, the controller can check whether the terminal really belongs to the passenger. The authorization-checking device includes reproduction means 92 and 93 in order to reproduce these authorization indications and identification data

optically and/or acoustically. These indications can for example be displayed on a display, for example on a LCD, of the checking device and/or read with a voice synthesizer and reproduced acoustically in the controller's headphones 93. In the represented preferred embodiment, these  
5 indications are projected optically with a VRD (Virtual Retina Display) device 92 onto the controller's retina.

Electronic encryption and signature means are preferably provided in order to encrypt the data transmitted over said contactless interface and to sign these data electronically. For this purpose, TTP  
10 (Trusted Third Party) mechanisms are preferably used. The identification module in the terminal preferably includes a private and a public key, so as to guarantee an end-to-end encryption up to the data processing means 2 and preferably beyond up to the external devices 1, 7, 8.

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